

ON
RETROBULBAR INCISION
OF THE
SHEATH OF THE OPTIC NERVE IN
CASES OF SWOLLEN DISC.

BY
ROBERT BRUDENELL CARTER.

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BY ROBERT BRUDENEILL CARTER.

I AM desirous to bring before the profession an account of an operation I have recently performed, by opening the sheath of the optic nerve behind the eyeball, in order to permit the escape of fluid in a case of great swelling of the termination of the nerve within the eye.

An operation for this purpose was first suggested by Dr. de Wecker, who, at the London meeting of the Quadrennial Ophthalmological Congress, in 1872, read a paper on the subject. He pointed out that the investigations of Schwalbe, continued by H. Schmidt, Manz, and others, had shown that the liquid contained in the arachnoidal space may in cases of exaggeration of intracranial pressure be forced through the optic foramen between the two coats of the optic nerve up to its insertion into the eye. Here the liquid, meeting an obstacle in the sclerotic ring, produces distension of the external coat on the one hand, and on the other, strangulation of the contents of the nervous sheath (fibres and vessels), which would explain the disturbance of vision, and the secondary atrophy of the nerve itself. Dr. de Wecker did not enter into any discussion as to the applicability of Schwalbe's theory in all cases, or as to whether the dropsy of the optic nerve is constant in every case of confirmed neuro-retinitis. He maintained it to be indisputable that in the great majority of necropsies the distension of the external sheath near the eye has been met with, and that Schwalbe's theory affords the most satisfactory explanation of the production and symptoms of neuro-retinitis. According to this theory, he considered that there were two indications to be fulfilled: in the first place, to give issue to the accumulation of the cerebral liquid by making an incision into the external coat of the optic nerve; and, secondly, to relieve the strangulation of the nerve by incising the sclerotic ring where it forms the junction of the sheath with the external enveloping membrane of the eye. By proceeding thus, he hoped to relieve the symptoms of compression, not only of the nerve itself, but those of the

cerebral centres—in other words, to remove the pain and inconvenience arising from the excess of intracranial pressure.

Dr. de Wecker went on to say, that he had performed the operation in two cases of cerebral affection (probably tumours of the cerebrum). In one of the cases, a man of 40 (whose right eye was operated on), neuro-retinitis was completely regressive in the right eye, and in the other regressive also. There was only a slight degree of vision, scarcely allowing the patient to do any work, even if the weakness of the legs, with which he was at the same time affected, had permitted it. The other patient, a woman of 30 (whose left eye was operated on), was completely blind, and was at the same time the subject of paraplegia, partial paralysis of the left facial nerve, and great difficulty of moving the tongue. She also suffered from incessant headache. The neuro-retinitis was in this case evidently regressive in both eyes, and especially in the left.

Dr. de Wecker described his operation by saying that he made an incision between the rectus externus and the rectus inferior muscles, at a distance of one centimetre from the margin of the cornea. Then, cutting the conjunctival and sub-conjunctival tissues, he penetrated between the eye and Tenon's capsule with a pair of probe-pointed scissors until he reached the optic nerve. He then introduced a spatula, and luxated the eye upwards and inwards. It was easy after the luxation of the eye to feel with the spatula the distended nerve, and to introduce a sheathed neurotome, an instrument made by M. Mathieu for the purpose. It consists of a stem curved to fit around the eyeball, terminating in a notched extremity intended to feel for and to embrace the nerve, and concealing a sheathed blade. Dr. de Wecker believed the mechanism of this instrument to be such, that by slight pressure on the spring only that part of the nerve would be cut with which the notch was placed in contact, at a distance of one centimetre behind the eye. The operator was to incise the sheath of the optic nerve and the sclerotic ring, moving and pressing the instrument from behind forwards. He would then remove the instrument, after having pushed the spring back, so that the blade could not cut more than was desired.

Dr. de Wecker stated the results of his two operations as follows :

1. There was no pain after the operation, which was performed without the aid of anæsthetics.
2. Very great relief of the headache, especially on the side operated upon.
3. On removing the bandage, twenty-four hours after the operation, there was a very slight congestion of the eyeball, and the pupil deviated to the opposite side of the penetrating wound, probably in consequence of rupture of the ciliary nerves.

This deviation of the pupil disappeared in a few days. 4. The operation having been performed in complete regressive forms of neuro-retinitis, no amelioration of sight was to be expected; nevertheless the male patient seemed to have improved in the operated eye, for in a week he was able to perceive the light. The beneficial result in this case seems to have been indisputable, and the medical men who assisted at the operation were of the same opinion, as there was a marked influence on the headache, and on the general state of the health. The male patient was able to stand more firmly on his legs, and to answer questions promptly. He seemed delighted with the operation, on account of the general relief he had experienced, although he had gained nothing as far as sight was concerned. The result of the operation was less manifest in the female patient, who was only relieved of her headache.

The ophthalmoscope did not discover the incision, which was perhaps not made deeply enough; but there was a slight increase in the volume of the vessels, especially of the veins.

In September 1872, Dr. de Wecker's experiment, if I may so describe it, was repeated by Mr. Power on the right eye of a girl of 13, this eye having been blind for two years, and having still some swelling of the optic disc. Mr. Power has favoured me with the notes of the case; but it is sufficient to say that, beyond a doubtful increase in the power of perceiving light, no beneficial effect was obtained.

Dr. de Wecker's paper greatly impressed me when it was read; but I could not escape from the conclusion, that a case of advanced optic-nerve atrophy, although possibly suitable as a *corpus vile* on which to demonstrate the practicability and harmlessness of the operation, was not one in which any good result could reasonably be expected. I felt, moreover, that the mode of procedure was extremely faulty, and that the structures concerned were far too important to be incised without the aid of sight. The least obliquity of direction of the unsheathed blade might cause it to divide one or more of the ciliary nerves; and, even if the blade were placed with diagrammatic correctness, the smallest excess of penetration might wound the central retinal vessels in the nerve trunk. The attempt to extend the incision through the sclerotic ring seemed to be especially perilous, and likely to lead to puncture of the choroid and to extravasation of blood within the eye in the neighbourhood of the macula lutea. In short, the operation, as described by Dr. de Wecker, appeared to me to be too uncertain and too dangerous to be justifiable in any circumstances, although I had no doubt of the soundness of the principle on which it was based.

During the last few years it has been my lot to see a large

number of cases in which, in connection with the growth of intra-cranial tumours, or with other morbid processes, there has been great swelling of the intra-ocular extremities of the optic nerves. In many cases of this kind sight is at first absolutely unaffected, the swelling being limited to the connective tissue of the disc and of the fibre layer of the retina, and being apparently produced by a moderate amount of mechanical impediment to the circulation, not enough either to arrest conduction through the nerve fibres, or to close the channels of the vessels. In some instances the swelling of the optic discs has disappeared under treatment, and complete recovery has ensued. In others, nerve atrophy and blindness have been produced; and these consequences may, I think, be explained in two ways. If I may dwell for a moment upon the anatomy of the parts concerned, it will be to remind the reader that the optic nerve is closely invested by a sheath derived from the pia mater, and this again, but loosely, by a sheath derived from the dura mater. Between these two sheaths there is an interval, or inter-vaginal space, which terminates in a cul-de-sac at the level of the back of the eyeball, where the dural and pial sheaths unite to blend with the sclerotic. This inter-vaginal space contains membranous processes derived from the arachnoid, and communicates with the sub-arachnoid space; so that, as was shown by the authorities cited by Dr. de Wecker, an excess of sub-arachnoid fluid will make its way into the intervaginal space, compressing the nerve trunk and distending the dural sheath, which, especially in the immediate neighbourhood of the eye, has often been found to be much dilated. The central artery and vein of the retina pierce the sheaths at a point which is from fifteen to twenty millimetres behind the eye: and it is manifest that compression of the lower part of the nerve trunk, in which the vein is still contained, must impede the return of blood, and must occasion dropsical swelling of the nerve termination within the eye, and of the adjacent retina, with turgescence of the retinal branches of the veins. The effect of such compression must depend upon its degree, and experience shows that it may be sufficient to produce distinct dropsical swelling, and that this may continue (within my own knowledge for more than three years) without any affection of the sight. On the other hand, the compression of the nerve trunk as a whole may increase so rapidly and to such a degree as quickly to destroy vision by arresting conduction through the fibres; in which case it must also arrest the flow of blood through the vein, an occurrence usually attended by hæmorrhages into the retina. When the compression increases more slowly, the consequent dropsical effusion may excite inflammation of the connective tissue of

the optic disc by mechanical disturbance of its structure; and this inflammation may in its turn give rise to an interstitial plastic exudation, which will gradually contract, and will produce atrophy of the disc by strangulation of its capillary vessels and of its nerve fibres. With the commencement of contraction vision begins to suffer, and is ultimately completely extinguished.

It is very common to hear all cases of swelling of the intra-ocular termination of the optic nerve described as "optic neuritis," but I am strongly of opinion that this description is erroneous. I am only too familiar with optic neuritis; and the first symptom of its existence is great impairment of sight, which, if the inflammation be not relieved, speedily passes into blindness. The neuritis is usually retro-bulbar in its origin; and some days may elapse, and central vision may be almost lost, before any evidences of exudation can be discovered in the disc. Even then, such evidences are often so slight that only a practised eye would detect them; and I presume that the part of the nerve primarily affected is in such cases posterior to the point at which the retinal vein emerges from the sheath, and that hence no mechanical or dropsical swelling of the disc is produced. I do not believe in the possibility of any true neuritis without marked derangement of the function of the affected nerve; and when I see, as I have often seen, considerable swelling of the optic nerve within the eye, continuing for weeks, months, or even years, without any injury to the sight, I feel convinced that such swelling is not neuritic, but only passive or dropsical, a result of impeded circulation. I have no doubt that dropsical swelling may excite a sort of spurious neuritis, in the way already mentioned, by the disturbance which the swelling occasions, but I regard this effect as being confined to the connective tissue, and not as constituting neuritis in any true sense; nor do I think that the mere presence of leucocytes in the optic disc affords evidence of any action to which the word "neuritis" can properly be applied. We have all seen cellulitis of the leg; and we have all seen a certain amount of inflammation, attended by erythema, as a consequence of dropsical swelling; but we should not describe a limb which presented the latter conditions as an "inflamed leg," even though it would no doubt contain leucocytes in abundance, and though the fluid in the meshes of the connective tissue were coagulable and plastic in its character. Notwithstanding all this, we should know that a few judiciously placed punctures, by allowing the fluid to escape, would speedily produce a change for the better; while, in actual cellulitis, not even free incisions would generally prevent destruction of tissue. To confound the two

conditions, on account of the presence of microscopic products common to both, would be to permit histological refinements to outweigh the evidence of broad clinical facts.

The cases to which I am now chiefly desirous to attract attention are those in which, after the persistence of optic nerve swelling for a certain time, without impairment of vision, such impairment at last commences, and proceeds more or less quickly to complete blindness. In some of these cases the loss of sight may be due to the development of a tumour or other intercepting lesion between the optic nerves and the cerebral centres of vision; but more frequently, in my judgment, it is due to one of the two causes I have mentioned, that is, either to rapid compression of the nerve trunk as a whole by increase of fluid within the dural sheath, or to slow strangulation of the capillaries and fibres by the contraction of an interstitial effusion of a plastic character. In some of these cases the primary lesion may be recovered from, in others it may not destroy life for a long period; but in both the patient is left blind.

I may mention, by way of illustration, the history of a gentleman who first consulted me on the 30th of September, 1885. He had then great swelling of both optic discs, but scarcely any affection of the sight. He continued much in the same state until the following April, when his sight began to fail, the previously existing swelling passed into atrophy, and in a few weeks he became totally blind. There is reason to believe that he has an intracranial tumour; but he is still in possession of his mental faculties, and although reduced in strength, has no paralysis. In thinking over his case, I determined that I would take the next opportunity of a similar kind to open the nerve sheath behind the eye, in the hope that the evacuation of the contained fluid would preserve the nerve from atrophy and the vision from destruction. Such an opportunity was afforded by the case which forms the subject of this paper, and which I will now proceed to relate.

E. O., a lady's-maid, 26 years of age, was brought to me by her mistress on the 18th of November, 1886. She had been somewhat out of health for a fortnight or so, had recently been exposed to cold when driving, and had received a blow, of no great severity, on the right parietal region of the head; but there was nothing very definite in either her history or symptoms. She had suffered for ten days from a good deal of aching pain across the forehead, and also in the occipital region, but her chief complaint was that, when rising on the morning of the 9th, she discovered that she saw imperfectly with the left eye. She could distinguish objects, but said that they looked dark and dim, and this state of the sight, although

varying a little from time to time, had remained substantially unaltered. Central vision of the left eye was found to be equal to about two-thirds of the normal standard, but the eye was blind as to the temporal half of its field of vision, and the field was much contracted in other directions also, as shown by the chart in Fig. 1, which was taken on the 26th of November. The left optic disc was swollen, and its margins were entirely concealed, the swelling encroaching upon the retina in an unusually broad zone of circumneural turbidity, through which not even the colour of the choroid could be seen. The central part of the swelling showed numerous small hæmorrhages, and its apex was best defined with a convex lens of four

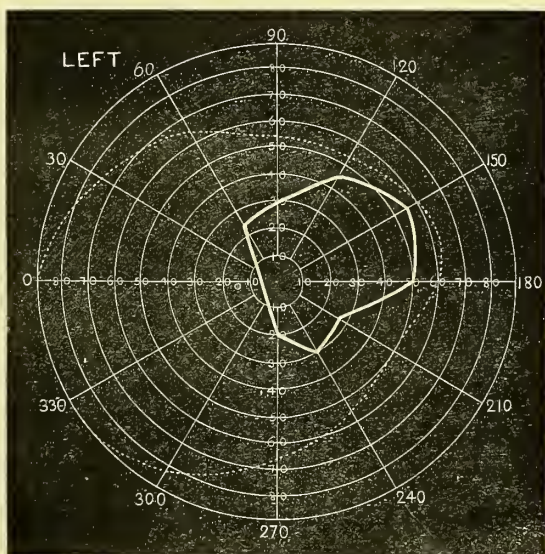


FIG. 1.

dioptries, which, allowing for one dioptre of hypermetropia, pointed to an actual elevation of one millimetre. Beyond the swelling, the retinal veins were distended and tortuous. The right eye was normal in aspect and vision, and had one dioptre of hypermetropia. There were no general symptoms of a kind to throw any light upon the essential nature of the lesion. The tendon reflexes were active, and there was a trace of ankle clonus.

The patient was admitted into the National Hospital in Queen Square, under the care of Dr. Hughlings-Jackson and myself, and she was placed upon iodide of sodium with mercurial inunction. She very soon became mercurialised;

but the only other obvious change in her condition was that the swelling of the optic disc, and the breadth of the turbid circumneural zone, continued steadily to increase. Some opaque white patches appeared among the effusion, a considerable hæmorrhage occurred over the position of the inner margin of the disc, and on the 17th of December, flocculent opacities in the vitreous were observed over the apex of the swelling.

The vision was at this time unchanged, but I felt that it was exposed to great risk from increasing pressure or from interstitial strangulation, altogether independently of any unknown lesion by which the origin of the local condition might be explained; and I determined, with the assent of Dr. Hughlings-Jackson, to repeat Dr. de Wecker's operation, if possible, in a more certain and satisfactory way. I convinced myself, by trial upon the dead subject, that the insertion of the optic nerve could only be exposed from the outer side of the orbit, and, after much consideration, I determined on the course about to be described.

On the 28th of December, the apex of the swelling being then best defined by a convex lens of nine dioptries, showing an actual elevation of close upon three millimetres, or twice the diameter of the disc itself, the patient was placed under chloroform, and the lids were widely separated by a rack speculum having its bar on the nasal side. I divided the conjunctiva and sub-conjunctival tissue in a vertical line, about a centimetre from the corneal margin, so as to expose the external rectus muscle a short distance from its insertion. I passed two strabismus-hooks under the muscle, and then, being provided with two threads of fine carbolised catgut, each carrying a needle at either end, I passed the two needles of one thread through the tendon, from within outwards, between its insertion into the sclerotic and one of the hooks, and the two needles of the other thread, also from within outwards, between the belly of the muscle and the second hook, and then divided the muscle between the hooks. The eyeball was next rotated inwards, while the orbital portion of the divided external rectus was lifted and turned outwards. By a succession of small scissor snips, I carefully divided the capsule of Tenon, and other resisting structures, to the necessary extent, and presently succeeded in bringing the insertion of the optic nerve into view. I had furnished myself with a fine sharp-pointed knife, and with a very delicate sharp hook, each mounted on a flexible platinum stem. I picked up and steadied the nerve sheath with the hook, and incised it with the knife, in the direction of the axis of the trunk, for perhaps a quarter of an inch, up to the insertion into the eye, but

without dividing the sclerotic ring. An escape of fluid showed the division of the sheath to be complete. As soon as this was seen, the eyeball was replaced, the parts of the divided external rectus were brought together by the sutures already in position, and the conjunctival wound was united by two others. Both eyes were closed and bandaged, and the patient was put to bed.

The operation was followed by no discomfort. There was no rise of temperature, the muscle united readily, and the external wound showed no irritation. On the next day the patient was somewhat nervous and excited, but on the third day she said that she felt quite well, and that she was completely relieved of the pain and "muzzy feelings" in the head by which she had for some weeks been troubled.

A mere glimpse with the ophthalmoscope, four days after the operation, showed that the swelling of the optic disc had diminished, but no complete examination was made until the 7th of January. By that time the broad zone of circumneural retinal opacity had disappeared, and the margin of the disc was visible around rather more than the outer half of its circumference. The best definition of the apex of the swelling was obtained with a convex lens of four dioptries, showing that the actual prominence had diminished by about one-half, or to what it was when first examined.

From this time forward the subsidence of the swelling, although not rapid, was steadily progressive. The remaining blurring of the inner margin of the disc has disappeared; and all the extravasated blood has been absorbed. The vessels of the disc are visible throughout the whole of their course, and there is no longer any impediment to the venous circulation. There is about one-third of a millimetre of remaining swelling, and the general aspect of the surface is still somewhat veiled and abnormal, but it seems to be in course of steady restoration to the natural condition. If I had divided the sclerotic ring, the recovery might possibly have been more rapid.

The acuteness of central vision has become normal, and early in March the field began to increase on the previously blind temporal side. The chart in Fig. 2 was taken on the 21st of March, in a very bad light, and the field has since undergone further extension.

The movements of the eyeball, and those of the pupil, are perfect, and there is nothing to show that any surgical interference has taken place. The general condition has lately undergone steady improvement, and there is, I think, reason to hope that complete recovery will occur.

The issue of this case seems to me to establish that the

operation devised by Dr. de Wecker, and which, as he endeavoured to perform it, I should not care to attempt, has been brought within the limits of safe and prudent surgery. The case shows that the sheath of the optic nerve can be exposed to view, that any fluid which it contains can be evacuated by incision, and that this can be accomplished without risk to the patient, or without the possibility, assuming the exercise of due care and skill, of any injury to the eye. If thus much be conceded, we have only to inquire in what circumstances, if in any, such a proceeding is likely to be advantageous to a patient.

For the purposes of such an inquiry, I should in the first

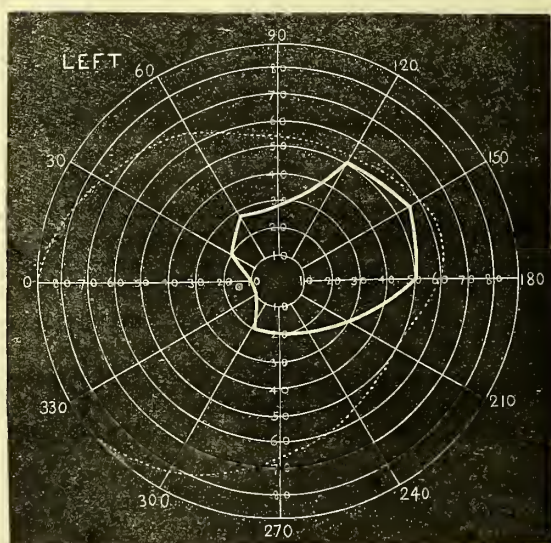


FIG. 2.

place exclude all cases in which swelling of one or both optic discs is apparently due to the presence of an intracranial tumour which can be localised and removed. Mr. Horsley's operations have shown that, in such circumstances, the removal of the tumour itself is followed by the subsidence of the disc swelling; and the results of the major operation would render the minor one unnecessary. But, apart from these cases, I think incision of the nerve sheath should be practised whenever swelling of one or both discs is attended by the commencement of impairment of vision. Such impairment might be caused, in some instances, by a lesion unconnected with the sheath, which its incision could not touch, but it would more

frequently be caused by external compression or internal strangulation of the nerve, and these conditions might certainly be relieved. It is well known that many cases of swollen disc go on to atrophy and blindness while the patient recovers, or at least does not die; and I feel strongly that, in most of these, sight might be preserved by the means to which it has been my object to direct attention.

We also see instances of loss or great impairment of sight, from nerve atrophy after various acute diseases, fevers, the exanthemata, and others, and in these we generally find ophthalmoscopic evidence that the atrophy has been preceded by swelling, probably as a consequence of some meningeal effusion. If it were the custom to watch the optic discs in all grave cases of this kind, especially on the occurrence of head symptoms, the commencement and the increase of swelling would be observed, and incision of the nerve sheath would not improbably preserve the sight in many instances.

I should by no means be without hope, moreover, of obtaining good results from the operation in a certain proportion of cases of real or primary optic neuritis, those of which I have already spoken as being speedily destructive to sight, and as being attended with a very small amount of disc swelling. In these, I apprehend, the neuritis is not only retro-bulbar, but also posterior to the emergence of the retinal vein; and it is highly probable that the inflamed and swollen nerve is compressed and injured by its unyielding sheath. Assuming genuine neuritis to exist, and the nerve to be suffering compression in the manner supposed, I cannot doubt that the relief of the compression might lead to the resolution of the neuritis; and I should be quite prepared, in any such case, to undertake the operation. I should introduce, through the first aperture in the sheath, a fine probe-pointed knife between the sheath and the nerve trunk, and should run this knife as far back as possible towards the apex of the orbit, in the hope of making an incision sufficiently long to relieve compression over the whole of the inflamed portion of the nerve. In the indicated conditions, and possibly also in others, I cannot but think that the operation I have described has a fair prospect of usefulness; and I beg leave to commend it to the attention of all those who are likely to have opportunities of testing it in practice.

POSTSCRIPT.

On the night of Sunday, the 22nd of May, the patient above referred to was aroused from sleep by the presence in her mouth of a quantity of nauseous fluid, some of which she swallowed before being quite awake. On procuring a light, what she was able to put out was tinged with blood. She was very sick, and the fluid continued to trickle into the pharynx for some hours, maintaining the sickness; but, in the course of a day or two, all her troubles passed away, and she has since appeared to be quite well. The position and nature of the discharging cavity can only be conjectured.

R. B. C.

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